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The Early Roots of San Diego's Innovation Economy

By Mary Lindenstein Walshok

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Academic research is underscoring how important cultural values and social dynamics are to turning R&D into regional economic development. San Diego, California, the home to some of the nation's most robust technology clusters, is an interesting example of how early regional land use decisions by the public sector, coupled with "venture" investments and a collaborative culture, have jump-started the growth of the new economy. These practices and collaborative culture have deep historical roots and are continuously reinforced by the organization known as CONNECT, which organizes hundreds of events annually that assure the knowledge flow, trust, and nimbleness needed in entrepreneurial ventures. Geographic propinquity and boundary-spanning activities enhance innovation.

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SAN DIEGO'S INNOVATION ECONOMY

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INTRODUCTION

Prior to the knowledge revolution, most great American cities built their economies on the natural assets and geographical attributes of the regions in which they were located: the expansive agricultural mid-West, the growth of industrial and trading centers on the transportation hubs, and the expropriation of natural resources such as coal or timber. All of these represent common themes in the economic history of most American cities.

In the case of San Diego, the natural environment was not hospitable to either large scale agriculture or manufacturing industries. Isolated in the corner of California with the Mexican border to the South, mountain ranges to the East and the Pacific Ocean to the West, San Diego was not destined to be a commercial transportation hub. Its arid climate represented enormous challenges vis-à-vis water and rainfall, and its topography, which is characterized by miles of hills and canyons, is not easily adaptable to grid-city development.

The early settlers of the region were people who, nonetheless, saw opportunity in the region. They saw the potential of its beautiful harbor for shipping; the potential for small scale agriculture through innovative uses of the limited water resources; and extraordinary opportunities for health and tourism because of the dry, temperate climate in an era where health problems such as tuberculosis, asthma, and arthritis were not easily treated. Early on, the region experimented, as did upstate New York, Chicago, St. Louis, and most great American cities, with various approaches to exploiting its natural assets and made a number of key land use decisions to assure economic growth opportunities.

CONNECT co-founders: Irwin Jacobs, Co-founder & Board Member/Qualcomm; Bob Weaver, Former Partner/ Deloitte & Touche; Richard Atkinson, President Emeritus /University of California; Lea Rudee, Founding Dean/ University of California San Diego School of Engineering; Mary Walshok, Associate Vice Chancellor for Public Programs, Dean of University Extension/University of California San Diego; Buzz Wooley, President/Girard Capital/Girard Foundation; David Hale, Chairman/Hale BioPharma Ventures (Chair of CONNECT Association Board); and Dan Pegg, Former President & CEO/ San Diego Regional EDC.

What is significant about the decisions made by San Diegans, based on the constraints imposed by their distinctive natural environment, is that San Diego's early economic development was concentrated on small family farms, small businesses, and entrepreneurial efforts to develop the harbor and land in the absence of financial resources. This resulted in a strategy to attract the Navy to the region, as a way of developing the harbor and much of the infrastructure on the bay at minimal cost to a small cash-strapped community. While other American cities in the mid-West and even on the West coast,

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such as Los Angeles, San Francisco, and Seattle, were building robust trading and manufacturing capabilities, San Diego continued to be a small town characterized by entrepreneurial, small business people, many of whom were drawn to the region because of its health giving attributes and beautiful climate, none of which, in its early history, they were able to turn into a major economic value.

San Diego never developed a set of major legacy industries such as steel or automobile manufacturing, or even aerospace manufacturing, on the scale of other early 20th century cities. It also meant that the accumulation of private wealth through the last century was insignificant compared to the accumulation of wealth in many other cities. These two characteristics of San Diego provide significant insight into the extent to which the region has a long history of having to rely on collaboration, adaptability, and opportunism to achieve economic goals. Without dominant industries and employers, San Diegans, for more than a century, were continuously "hustling" for the next economic growth opportunity.

By the early 1950s, highly valuable plots of land known as the Torrey Pines Mesa (which were primarily home to a Boy Scout camp, hiking trails, and a municipal golf course, which was to become the revered Torrey Pines Golf Course) were re-zoned for light industry and R&D.

The most significant development for San Diego came with the opening of the Panama Canal and the dawn of the Pacific Century in 1915. The Pacific Century, as coined by Teddy Roosevelt, represented a major opportunity to expand trade and America's military presence across the Pacific and into Asia. San Diegans exploited this opportunity by parlaying valuable land into a number of military installations, dredging the harbor in order to house the Pacific Fleet, and providing a wide range of services in order to establish a major Pacific-facing presence for the United States military in the region. By the 1920s and well into the 1980s, San Diego was typically characterized as a "martial metropolis".

In the post-World War II years, there was a dawning anxiety among civic leaders about the potential diminishment of the military presence in San Diego, which had come to represent more than 60 percent of the regional GDP. Civic leaders recognized the need to diversify simultaneously with the recognition among some of the major military contractors such as Convair, which had built nuclear submarines and was testing nuclear airplanes, that R&D and advanced technology were needed for the modern military, particularly, on the brink of the Cold War era. The effects of the atomic bomb and the enormous advances in technology during the war effort resulted in a new focus on military-related advanced R&D.

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By the late 1950s, the region had a new focus with the anchor tenants such as the Salk Institute, the new University of California campus with the powerful Scripps Institution of Oceanography, as well as a new medical research institute associated with the Scripps Hospital established in 1922, and, of course, General Atomics. Combined, these represented a new concentration of well-funded research facilities and thousands of new jobs, the majority of which were for Ph.D.s and advanced technical talent which had to be attracted to the region.

THE HIGH GROWTH YEARS: 1960-1990

Prior to the 1960s, San Diego had none of the assets one associates with technology hubs today. These assets which are universally recognized today include:

- Land and facilities dedicated to research and education;
- Large competitive basic research institutions;
- High levels of patenting and licensing;
- Angel and venture capital essential to starting and developing businesses;
- The talent – inventors, technology entrepreneurs, and technology business startup know-how; and
- Access to global partners and markets for advanced technology products.

As the research institutions were being established on the Torrey Pines Mesa in the early 1960s, San Diego continued to be a town that lived off military bases, tourism, and real estate development. During the Cold War era, it continued to have valuable defense contracting industries but, increasingly, these were industries focused on developing new and advanced technologies for national security and warfare such as GA, SAIC, and Titan.

An additional strategy, and a unique one nationally, that enabled the incredible growth of technology-based clusters in the region was the decision by all of the early

research institutions, including the University of California, to build research excellence from the top down. In the 1960s and 1970s, there was a flurry of activity around attracting top-level, well-connected, already funded and recognized scientists to the region. What institutions like Scripps, Salk, and GA promised these scientists was the opportunity to work on the newest, most interesting questions in science, unencumbered by traditional university culture and bureaucracy.

It was also a time when new facilities could be built with funds available at the state and national levels and when R&D dollars were expanding at exponential rates. This meant that by attracting a few senior level people an institution could accumulate millions of dollars in grants for facilities and projects which translated into new research and technical jobs to support the work of the senior scientists.

Throughout the '60s and '70s, there was a significant growth and diversification of the research community resident in the region. The sorts of people that were attracted to the region had strong reputations and established connections with national foundations, federal agencies and, in many cases, with the financial communities that had supported the growth of industries around MIT and Stanford during the '50s, '60s, and '70s. A whole new community of intellectual capital began to aggregate in the region, and the work it did in research and teaching generated hundreds of millions of dollars in construction contracts for labs and facilities. Demand for thousands of new houses and opportunities for thousands of new jobs it created began to shift the focus of the regional economy. Once again, the growth in federal research funding and the Cold War national security concerns fueled much of this research activity.

What is interesting about the entrepreneurial and adaptable character of the San Diego business community, as well as the innovative research community, is how quickly it adapted in the mid-1980's, when the Berlin Wall came down and the Cold War "officially" ended, to America's new focus on the new global economic competitiveness.

- By the mid-1980s, cars manufactured by Volvo, Mercedes-Benz, and Toyota were giving General Motors and Ford a run for their money.
- By the 1980s, Japanese semi-conductors were competing with Silicon Valley and Route 128 producers.
- By the mid-1980s, Europe and Japan have recovered from the devastations of World War II and their science and education capabilities were not only matching those of the United States in the previous 25 years, but in many cases exceeding them.

Coupled with advances in new technology and the emergence of the World Wide Web, the economic opportunities and challenges confronting the United States had become permanently altered.

In the San Diego context, the growth of the research institutions, from the 1960s into the mid-'80s, had been superb for the regional economy, in terms of creating new jobs related to research and teaching activities. However, all of the research that had become concentrated on the Torrey Pines Mesa had yet to produce a critical mass of spinoff commercial companies that would create new wealth and new jobs for the region in the magnitude that had happened in Boston and the Silicon Valley in the previous decades.

Since 1979 the TaylorMade mission has remained the same: Create the Best Performing Golf Products in the World. The company is part of the sports innovators cluster in San Diego.

Once again, entrepreneurial business leaders and entrepreneurial science leaders came together in the mid-'80s to address how to develop and accelerate commercialization in the region in order to grow science and technology – based clusters that could create both wealth and high-wage jobs for the region. It was at this point that yet another new community collaboration emerged involving co-investments and volunteer activities within the business and research community. This was dramatically represented by the founding of the University of California San Diego CONNECT.

CONNECT was founded 27 years ago to create a set of activities and a web of relationships that could support startup and high-growth technology companies. It was formed by a group of 30 individuals, each of whom initially put in a small sum of money to get it started. It focused on increasing the business community's so-

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phistication about science and technology, at the same time increasing the research and scientific community's knowledge of business and, especially, marketing, so that a genuine community of innovation could grow in the region. It was clear to leaders in the region that what made Route 128 and the Silicon Valley work was the fact that both were built on webs of relationships, trust, and shared risk, as well as the first-rate science, access to capital, and entrepreneurial know-how.

THE ROLE OF CONNECT

The role of CONNECT, which started with 30 members and $75,000 dollars and today represents a web of 3,000 individuals and organizations and an annual budget of $3 million, was critical to the growth of technology clusters in the region. CONNECT has become one of the preeminent boundary-spanning organizations in the science and technology business development space.

Early on, CONNECT recognized that in order to grow innovative technology companies you needed scientists and engineers who understood how to transform their technologies into useful products or services, which meant knowledge of markets, financing, and competitors. However, it's not enough to have business-savvy scientists. A community also needs business service providers who are knowledgeable about developments in science and technology, who understand regulatory and financing issues in the science and technology space, and are sophisticated about regulatory affairs and global competiveness issues. To this end, the CONNECT program brought together the full array of inventors, innovators, entrepreneurs, and business service providers that make up the ecosystem of innovation.

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Predominantly a volunteer-based organization, CONNECT focuses on helping evaluate and qualify technologies; develop early financing for proof of concept and business startups; capitalize new product development enterprises; assist in securing progressive levels of funding; understand market opportunities; secure partners; go public; merge a company or sell a company. It, basically, supports the incubation and development of an idea through the development of a viable company that creates both wealth and jobs for the region.

Over its short lifetime, the organization has assisted more than 3,000 companies through its various programs. It has been credited by most observers, including Michael Porter in his study of San Diego's regional innovation clusters, as the pivotal factor in San Diego's phenomenal growth.

Recent companies reported by CONNECT include Biomatrica, a bio stability company which allows researchers to move samples out of the freezer and into Biomatrica's room temperature stabilization and storage system. Its chief scientific officer and co-founder Dr. Rolf Muller says: "Springboard provided great exposure for our company. We obtained customers, investors and board members. A great program! … CONNECT was a huge help because scientists need help from people who know something about business." In 2006, Biomatrica went through CONNECT's Springboard Program and won the Most Innovative Product of the Year Award in San Diego. It also closed on a one million dollar round of investment funding in 2006. In 2008, it closed on a 7.2 million round of angel investment, again, assisted by CONNECT.

A second example is Benchmark Revenue Management. This is a web-based financial management system which has been assisted by CONNECT over the last three years. Its CEO, Tyson McDowell, has said: "I used to think the guy on the other side of the table was an idiot, but CONNECT helped me to articulate the pitch about my company so that people really do believe in

Biomatrica products are used for biomedical research across academia and industry.

me. CONNECT's lessons have served us incredibly well with management boards, employees and investors." In 2007, the organization helped the company secure $1.7 million in seed funding, and in 2009, after a presentation in CONNECT's Deal Network, it closed on another one million dollar plus round of angel investments.

The commercialization successes coming out of CONNECT are of many types. A good example is QwikLite which developed a technology licensed from SPAWAR using bioluminescence as an indicator for contamination. It completed a Springboard in 2006 and received funding in 2007. Another technology licensed from San Diego State University, which is a therapeutic method to reduce tissue damage resulting from heart attacks, completed an innovation assessment in 2007, participated in a Springboard in 2008, and then secured funding in 2008 as well. The company, Radical Therapeuticx, cited such benefits of its involvement with CONNECT as having feedback on market potential, company growth strategies, connection to entrepreneurs, and recruitment of a scientific advisory board.

These brief examples can be multiplied by the thousands and are enabled by the activist boundary-spanning activities of CONNECT, located on the Torrey Pines Mesa and in the hub of the clusters that are being developed there.

QwikLite® 200 Biosensor System Disposable Test Kits

The region benefits not only from CONNECT but from a multitude of boundary-spanning organizations which have sprung up in recent years. In fact, within a few years, a variety of other technology-focused industry associations emerged to complement the start-up work of CONNECT: BIOCOM, CommNexus, the Software Industry Counsel, the Venture Capital Organization, and the San Diego Venture Group – each of them representing a boundary-spanning organization which sponsors hundreds of events annually where scientists, engineers, attorneys, investors, real estate developers, accountants, and marketing professionals meet, establish relationships and, eventually, "do deals." This culture in San Diego's innovation community echoes a long history of small business leaders in San Diego collaborating to realize new economic opportunities through shared investment and mutually reinforcing efforts.

SAN DIEGO TODAY

In contrast to the 1950s when there was virtually no research going on – no major educational institutions or resident research institutions in the region, much less venture capital or technology based companies other than defense contracting entities – San Diego today has a diverse innovation economy characterized by six major clusters. A recent CONNECT innovation report to the community provides a snapshot of the robustness of San Diego's innovation economy today. It begins with what they call the core – the core of *research institutions* agglomerated primarily on the Torrey Pines Mesa. Starting with the Scripps Institution of Oceanography founded in 1907 and General Atomics founded in 1955, today, that core has more than 60 research institutions including the University of California San Diego, the Salk Institute, and Sanford-Burnham Medical Research Institute.

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In terms of *defense and security*, San Diego, in the 1930s, had a few aviation and ship building companies and, today, it has a defense and security industry cluster of over 600 companies including SAIC, Lockheed Martin Corporation, and Northrop Grumman. San Diego, a long-time home for communications research for the Navy, by the post-War era, quickly expanded its wireless and software capabilities. Many of the young faculty who came to the University of California San Diego campus in the 1960s created innovative companies which today are the anchors in a 500-company *wireless cluster*, which includes internationally known companies such as Qualcomm, ViaSat, Broadcom, and LG Electronics.

San Diego is also known as the second or third leading *life science/ biomedical cluster* in the United States. Here, again, agglomerating on the Torrey Pines Mesa, from the 1960s onward, around the Salk Institute, the University of California San Diego, and the medical research institutions in the region, is a cluster of extraordinarily dynamic small innovative biomedical companies, as well as larger well- known facilities such as Lilly, Pfizer, Life Technologies, Novartis, and GenProbe.

In *energy and biofuels*, the region has also spawned more than 300 companies, over the last 40 years, building on the early research activities of General Atomics which was founded in 1955 as a research spinoff of the General Dynamics Company. Today, Sempra Energy, Sapphire Energy, and Synthetic Genomics led by the internationally recognized scientist Craig Venter are anchors in this cluster.

Finally, San Diego, which in the 1950s had a single surfboard company – Gordon and Smith – today supports a 600-company *sports innovators cluster* focused on composite materials and new technologies that enable the development of flexible sporting equipment in a variety of sectors. Golf products (Callaway Golf, TaylorMade Golf Company), surfboards, skateboards and helmets with built-in wireless phones for cyclists and hang gliders – all are being developed in the San Diego region.

This extensive list of companies represents an extraordinary asset to the region. It enables San Diego to have a large globally traded sector which produces high-wage jobs and significant ripple effects on the regional economy. Were one to look at the map of San Diego, one would see that all of the described companies agglomerate on and around the Torrey Pines Mesa and benefit from significant interactions among one another, with the research community on the Mesa, and the wide array of marketing, legal, financing, and business service resources they can draw upon.

CONCLUSIONS AND IMPLICATIONS

The diversity of technology clusters which have evolved in the region can be directly tied to the valuable land use decisions made in the region throughout the 20th century, most especially dedicating a vast undeveloped area of the city for research and development as well as science and technology companies. These land use decisions were further supported by social initiatives to collaboratively develop entrepreneurial companies in the region. The existence of six distinct clusters allows for a great deal of convergence across scientific and technical areas and, today, San Diego is incubating new globally competitive technologies in such areas as wireless health applications, stem cells, and renewable energy.

J. Craig Venter co-founded Synthetic Genomics Inc. to commercialize genomic-driven technologies. Dr. Venter and his teams have proven track records of making scientific breakthroughs that translate into viable commercial solutions.

Despite the unique history of the region, there are some critical factors in the San Diego story which might inform how other regions begin to create the culture, the energy, and social dynamics that are clearly boundary spanning. The possible implications of the San Diego experience for economic developers and regional planners from other parts of the country are highly nuanced. This is because every place has its own distinctive geography, history of settlement and population growth, as well as distinctive industrial legacies. All of these significantly shape the embedded practices, expectations, and values that become dominant in any given region.

As this brief article has postulated, small entrepreneurial local businesses, locally anchored military technology, and R&D-focused efforts evolved over time, creating a critical path to achieving what today is a very robust entrepreneurial, science and technology-based economy. This sector represents about 140,000 jobs in the region, 6 percent of the employers, and 11 percent of the jobs, but accounts for 25 percent of the wages in the region. While overall employment in the region recently decreased by 6 percent, tech employment is down by only 2 percent. The median wages in this sector are $90,000 a year, and the ripple effect is significant.

Also significant is the diversity of technology clusters which have evolved in the region. This has allowed for very interesting forms of convergence across scientific and technical arenas in recent years – for example, San Diego is incubating a new health IT cluster as well as a wireless health cluster. Because of the momentum, built over the past 40 years in attracting very large federal research grants, San Diego has continued to be number one in the state in research per capita.

Increasing amounts of private sector and philanthropic funding have also emerged. One individual, Denny Sanford, for example, has contributed close to $80 million in less than two years to support facilities and research scientists on the Mesa. Exxon/ Mobile has committed up to $600 million over ten years to support the work of Synthetic Genomics, a company founded by Craig Venter, who, with close to $40 million in private foundation funding, has launched a Center for Microbial Genomics. Success begets success in the age of science and technology.

Despite the unique history of the region, there are some critical factors to the San Diego story which might inform how other regions can begin to create the culture, the energy, and the social dynamics needed to grow the sorts of collaboration-based science and technology clusters that promise new wealth and high wage jobs.

Clearly, the boundary-spanning networking activities between the business and science and technology communities are essential. The San Diego case and similar cases would suggest that integrative organizations such as CONNECT and BIOCOM, that organize hundreds of events annually, contribute to building a community of innovation out of which comes shared knowledge, mutual trust and, with that, increasing willingness to collaborate and take risks.

Zoning decisions and repurposing traditional geographies and facilities to new opportunities and imperatives can make a difference. Re-purposing existing tracts of land or building complexes to support new innovative companies and research enterprises can be very positive. Finally, innovative approaches to co-investing in financing of facilities and leveraging of local foundations and corporate contributions with state and federal monies can help create momentum. All of these things occurred in the early history of San Diego and have occurred again and again as the region has had to face the challenges of reinvention and refocusing the direction of its economy.

The San Diego experience is not all rosy. In San Diego, like many other communities across the United States, middle class jobs are not being created as quickly as ser-

vice jobs. This is, in part, explained by the fact that entrepreneurial technology companies, in their early days, need a highly educated, nimble workforce and, therefore, primarily create jobs for engineers, accountants, and people with legal and marketing skills.

The salaries for engineers, scientists, technicians, and high-level professionals average over $90,000 a year which can have a very positive impact on the economy. However, entrepreneurial startup jobs do not, in the short run, create opportunities for manufacturing and supplier networks that often represent the middle class jobs that communities need. In addition, the creation of these high-wage jobs can drive up the costs of housing and other services, creating barriers to middle class and low-income people living in the region.

The San Diego region is in the process of grappling with this paradox and CONNECT has launched a new initiative focused on "nearsourcing." The goal is to connect the small and medium-sized manufacturing and supplier industries which have served the defense industry for decades to the new technology companies being developed in the area by matching needs and capabilities. In some cases, this means upgrading equipment and skills among supplier and manufacturing firms. It also means getting tech companies to better articulate what it is they need for the products they are developing.

The benefit of the entrepreneurial technology clusters to regional prosperity and prominence are enormous, but those benefits need to be translated into strategies that can assure continuing prosperity for middle and working class constituencies as well. To do this requires civic leadership that values a diverse economy and prosperity for all. But, it also requires economic development professionals who know how to think in very comprehensive ways.

Economic development is not exclusively about inner-city redevelopment or helping poor and disadvantaged workers find jobs. Economic development cannot be exclusively about helping entrepreneurial companies grow their industries and create high-wage jobs in the S&T sector. Economic development cannot be exclusively about attracting large employers into the region who bring jobs with them. More and more, the economic developer has to have the capacity to do all three.

Hopefully, the examples from the San Diego experience provided in this brief article will stimulate economic developers to diversify their approaches so that all communities will be better positioned to support comprehensive approaches to regional economic development and, most especially, integrate strategies for growing knowledge-based clusters into those efforts.